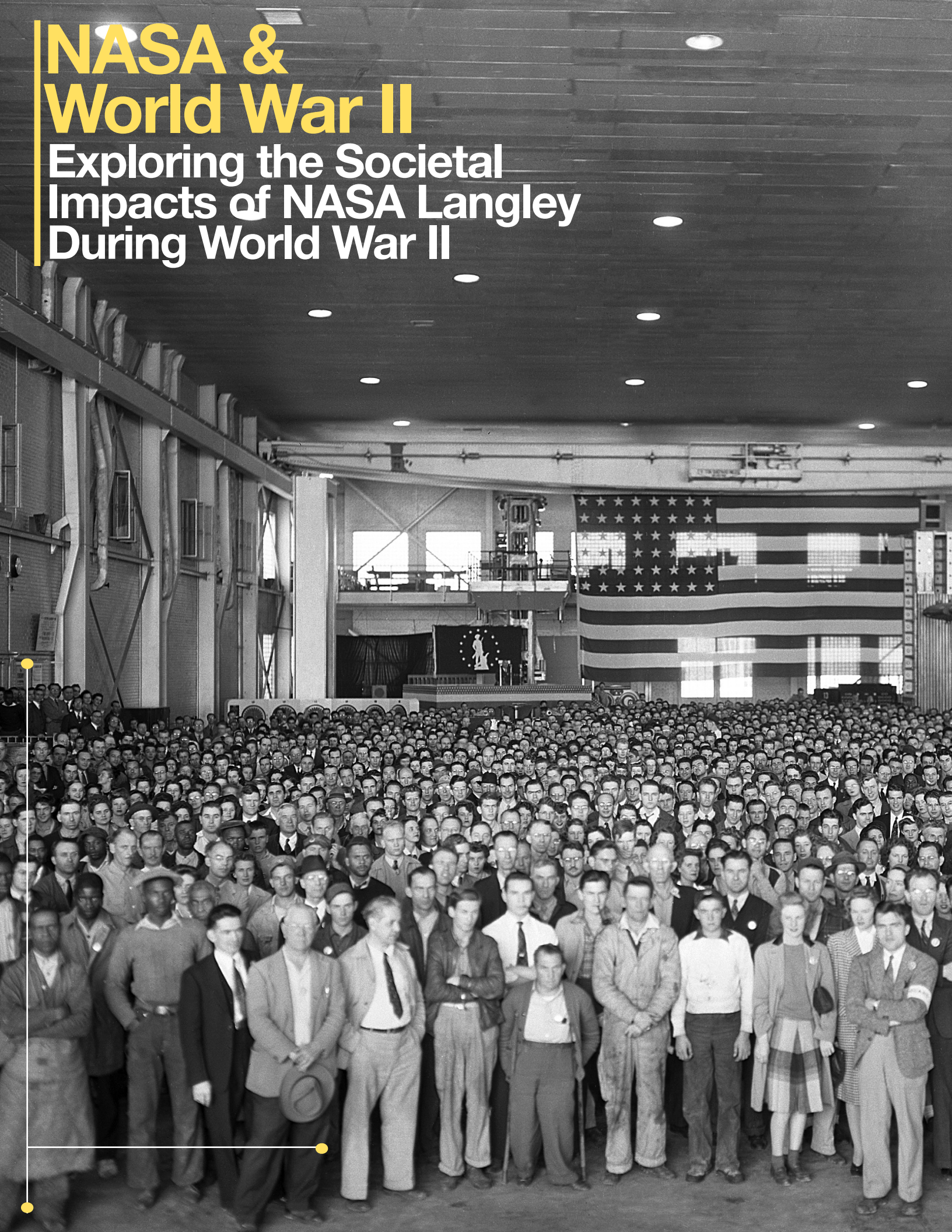
NASA & World War II

Exploring the Societal Impacts of NASA Langley During World War II



Lesson Plan

Previous Knowledge & Materials Needed: Previous knowledge of key events of World War II; computer access; DBQ activity; writing materials

Virginia Standards of Learning: Standard VUS.12: The student will demonstrate knowledge of the effects of World War II on the home front by: a) explaining how the United States mobilized its economic, human, and military resources. b) describing the contributions of women and minorities to the war effort. d) describing the role of media and communications in the war effort.

Essential Question: What impacts did NASA Langley have on American society during World War II?

Objective: This project is intended to be used in a high school social studies class. It was designed to familiarize students with the impacts of NASA Langley on American society during World War II. Students will be asked to partner with a peer and examine eight documents by answering analysis questions for each document. Research shows that working in small groups is a beneficial learning opportunity that allows students to collaborate and engage one another in rich discussion (Cohen, 1997). Primary source analysis will be guided by scaffolded question prompts that cover a range of lower level and higher level analysis and critical thinking skills. Throughout the project, students will be asked to comprehend, apply, analyze, and synthesize information in order to develop a thorough understanding of content (Bloom, 1956). Students will conclude the project by individually writing an evidence based persuasive essay that responds to the essential question.

Procedure:

1. Teacher will introduce the project topic by reviewing key events of WWII the NASA Langley Research Center
2. Teacher will hand out project instructions, review the instructions, and ask questions for clarification
3. Students will find a partner and investigate the eight provided documents by discussing and answering analysis questions together
4. Students will then independently begin fill out the evidence chart and craft thesis statement to be used in essay
5. Students will complete project by independently composing an evidence based persuasive essay in accordance with project guidelines
6. Students will submit work to teacher for grading and evaluation

Suggested Time Allotted: It is recommended that this project cover a period of 1-3 class sessions. Classwork, homework, and paper dates and deadlines should be assigned in accordance with the individual teacher's needs and preferences.

Evaluation/Assessment: Students will be evaluated on an individual bases using the included grading rubric.

Extended Learning Opportunities: http://crgis.ndc.nasa.gov/historic/NASA_Cultural_Resources_(CRGIS)

Name_____

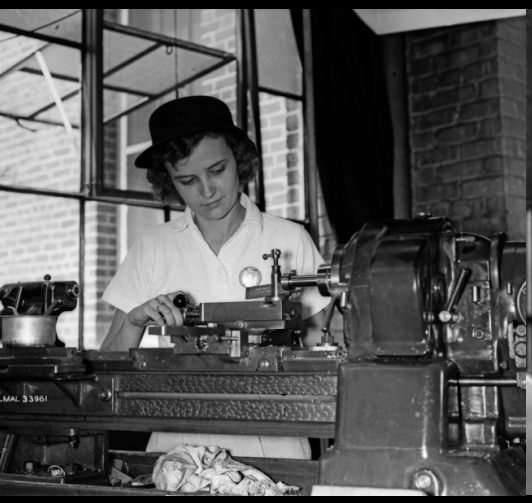
NASA & WWII: Document Based Question

DIRECTIONS: In a document-based question assignment your task is two-fold. First, you must review a series of documents and become familiar with what each document is saying. Then, once you have a good understanding of each document, use them to write a 5-paragraph response to the writing prompt given below. This writing prompt is based on the accompanying documents. It is designed to test your ability to work with historical documents. Therefore it is expected that you will use, reference, or cite these documents in your writing.

NASA LANGLEY & WWII IN A HISTORICAL CONTEXT: As the United States entered WWII, the importance of aeronautical and technological development become imperative. In Hampton, Virginia, the Langley Memorial Aeronautical Lab became the premier location for aviation development throughout the war. As NACA strove to meet government and military needs during the war years, employment grew and research facilities expanded exponentially. In order to adequately meet research and production demands, employment opportunities opened for women and African Americans. Through the exploration of eight documents, this project will explore the following three topics associated with NASA Langley during WWII: (1) employment opportunities, (2) technological development, and (3) gender roles.

As you read each document, consider them in the frame of this question:

How did NASA Langley impact American society during World War II?

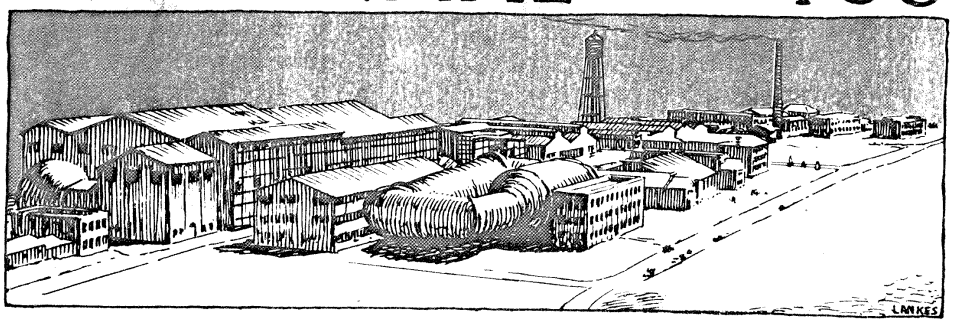


Part 1: The Documents

Directions: As you analyze the documents, take into account both the source of each document and any point of view that may be presented in the document. Take your time. You want to think of historical documents like crime scenes – you don't want to miss any piece of evidence! To help you, there are a several analysis questions after each document. Answer each of these for each document before moving to part 2.

Document 1 & 2: NACA-LMAL and You, 1944. Excerpts from a booklet created to acquaint new employees with NASA Langley (NACA) facilities and community.

NACA-LMAL AND YOU



NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, LANGLEY FIELD, VA.

THE National Advisory Committee for Aeronautics is the Federal Government agency to direct and conduct scientific research in aeronautics.

It was established on March 3, 1915 by Act of Congress. With responsibility to improve the efficiency, safety, and speed of aircraft, the NACA has been called "the force behind American air supremacy."

Under war conditions, the NACA confines its experimental investigations to those requested by the Army and Navy and to fundamental research relating to war problems.

As a member of NACA's Langley Memorial Aeronautical Laboratory (LMAL), your part in the total contribution of the Laboratory may be as significant as any part used in the airplane to insure its maximum effectiveness for combat.

Even the best equipment and facilities, the most brilliant engineering, and the most skilled craftsmanship are not enough in themselves. Perhaps the most significant factor at the LMAL is the teamwork of its employees. Such a spirit of friendly co-operation will ever remain essential to maximum achievement.

The wartime objective of NACA research is to improve the military effectiveness of American airplanes. To this end, we welcome your suggestions and offer you special training and educational facilities.

The professional careers of most of our "top men" started here at the Langley Laboratory. Your career at the LMAL is in your own hands; and your possibilities are practically unlimited.

Mr. Richard C. Dingeldein

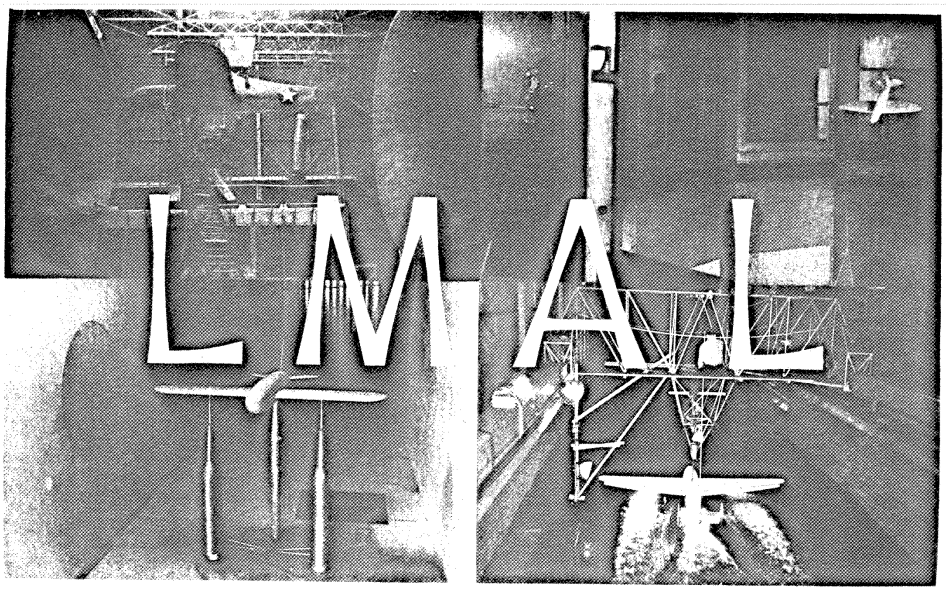
This booklet has been prepared to help you get acquainted with the Laboratory and the Community. We hope you will find your associations here pleasant and thus will be better able to serve the N.A.C.A. in its important war work. Welcome!

H. J. E. Reid.

Engineer-in-Charge,
Langley Memorial Aeronautical Laboratory

1. *What is the wartime objective of NACA research?*

2. *Why was this vital to the war effort?*



NAMED for Samuel Pierpont Langley, whose "Aerodrome" failed just nine days before the Wright brothers succeeded, the Langley Memorial Aeronautical Laboratory, established in 1917, has grown extensively - as portrayed in the graphs on the previous page.

Looking back over the war record, we find that the LMAL has contributed something essential to the military effectiveness of every type of American fighting airplane.

Now, under stress of war necessity, the LMAL is doing work that is most fascinating and of vital importance in the field of aviation. The work is as inclusive as the "problems of flight."

At the LMAL a great assembly of wind tunnels makes possible investigations of airplanes or airplane parts under specifically controlled conditions, such as low turbulence, variable density, high speed, etc. In addition, research is carried out on airplanes in flight.

In the impact basin and two hydrodynamic tanks, investigations are conducted on models of flying boats and on problems relating to landplanes "ditching" on the water.

An interesting example of the type of work is the subjecting of built-to-scale dynamic models to simulated flying conditions. Operators control these models by means of electro-magnetic devices, observe the results and photograph the behavior of the model for more detailed study.

Because of the rapid progress of aeronautical research, it is impossible to purchase all equipment necessary for this experimentation. Consequently, much of our work involves the origination, design and construction of technical equipment and highly specialized instruments.

Research is dependent on precise coordination of all of the contributing work being done. Every job at the LMAL is, therefore, important as a vital part of our contribution to war-time and post-war aviation.

Accordingly, it is expected that every employee shall be willing to work hard and to work on any shift and for any reasonable number of hours, as the job requires.

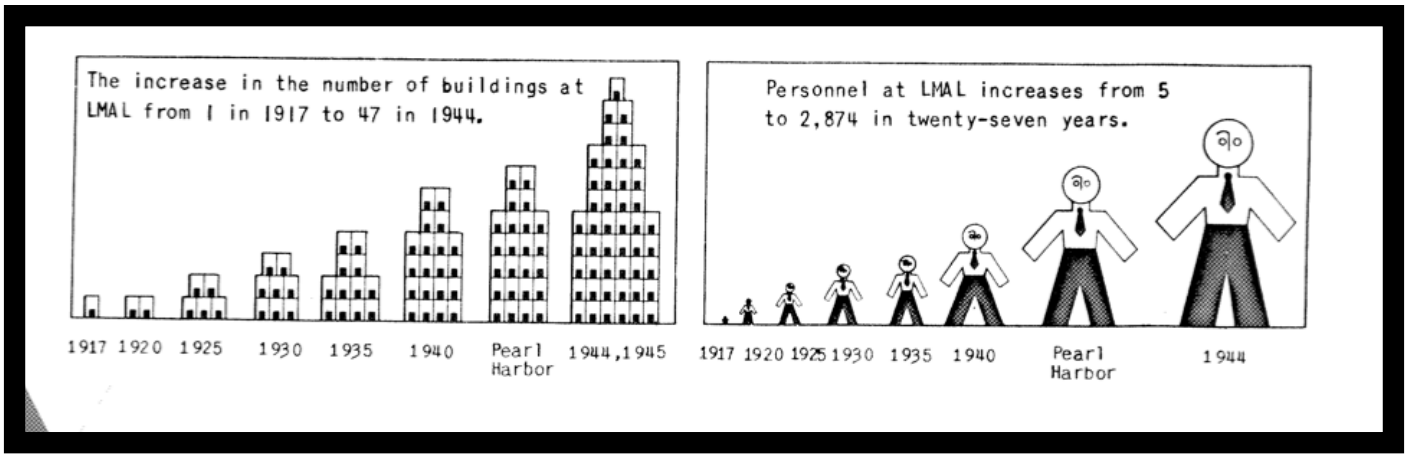
As you utilize your highest skills more and more, you can be confident that here you are making an important contribution to the war effort.

2. According to this document, how was aviation research conducted at LMAL?

3. What is an example of a specific tool is used to research aviation?

4. How do you think the technological development discussed in this document could have impacted society?

Document 3: *NACA-LMAL and You,* 1944. Two graphs demonstrating the growth of NASA between 1917 & 1944.



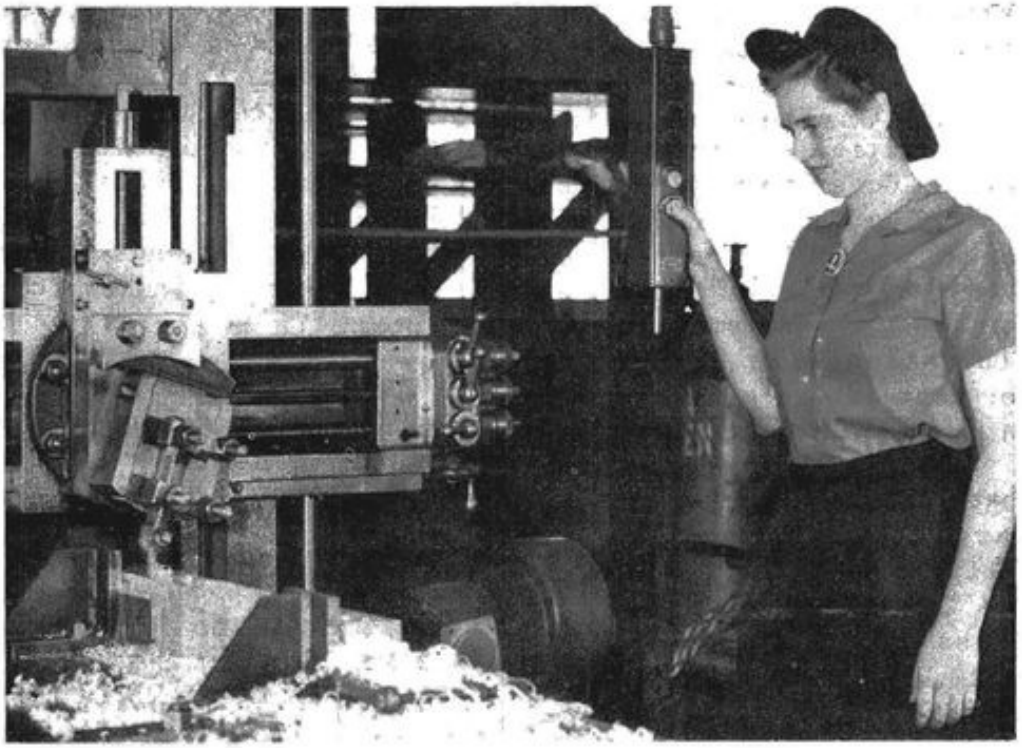
1. What is similar about these graphs, and what does this suggest about NASA between 1917 and 1945?

2. What is the only date listed by name (not by year) and why do you think it is included on the x-axis?

3. How could the growth demonstrated in these graphs could have impacted American society?

Document 4: *LMAL Seeks 200 Women Shop Workers,* 1943. This is a clip from an article from *Air Scoop* discussing LMAL/NACA's employment of women during WWII.

LMAL Seeks 200 Women Shop Workers



TWO HUNDRED new employees are being sought for work as Minor Laboratory Apprentices at LMAL, where they will perform duties similar to those of Mrs. Frances L. Powell (above), who is operating a planer in the West Area Machine Shop. T. Melvin Butler, Personnel Officer, said they will be given practical training and then assigned to the various shops. A memorandum, issued to the staff, describes the need for additional non-draft eligible personnel, especially women shop workers. A questionnaire on the reverse side of the memorandum may be used by staff members in listing their recommendations.

1. What kind of positions are women being sought to fill in this article? What kind of work will they be doing?

2. During this time period, how could the mass employment of women have positively impacted American society?

Document 5: Excerpt from R.J. Bilstein's book, *Orders of Magnitude: A History of NACA and NASA, 1915-1990,* 1989.

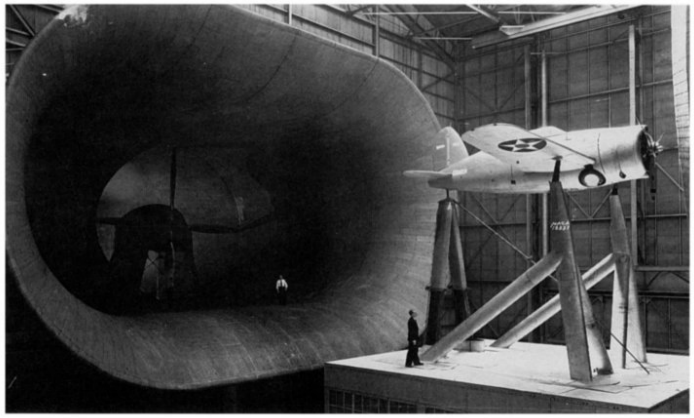
The War Years

Even though Langley and the NACA had contributed heavily to the progress of American aviation, there were still some in Congress who had never heard of them. Before World War II, a series of committee reports brought a dramatic change. During the late 1930s, John Jay Ide, who manned NACA's listening post in Europe, reported unusually strong commitments to aeronautical research in Italy and Germany, where no less than five research centers were under development. Germany's largest, located near Berlin, had a reported 2000 personnel at work, compared to Langley's 350 people. Although the Fascist powers were developing civil aircraft, it became apparent that military research absorbed the lion's share of work at the new centers. Under the circumstances, the NACA formed stronger alliances with military services in the United States for expansion of its own facilities.

In 1936, the agency put together a special committee on the relationship of NACA to National Defense in time of war, chaired by the Chief of the Army Air Corps, Major General Oscar Westover. Its report, released two years later, called for expanded facilities in the form of a new laboratory--an action underscored by Charles Lindbergh, who had just returned from an European tour warning that Germany clearly surpassed America in military aviation. A follow-up committee, chaired by Rear Admiral Arthur Cook, chief of the Navy's Bureau of Aeronautics, recommended that the new facility should be located on the West Coast, where it could work closely with the growing aircraft industry in California and Washington. Following congressional debate, the NACA received money for expanded facilities at Langley (pacifying the Virginia Congressman who ran the House Appropriations Committee) along with a new laboratory at Moffett Field, south of San Francisco. The official authorization came in August 1939; only a few weeks later, German planes, tanks, and troops invaded Poland. World War II had begun.

The outbreak of war in Europe, coupled with additional warnings from the NACA committees and from Lindbergh about American preparedness, triggered support for a third research center. British, French, and German military planes were reportedly faster and more able in combat than their American counterparts. Part of the reason, according to experts, was the European emphasis on liquid-cooled engines that yielded benefits in speed and high altitude operations. In the United States, the country's large size had led to the development of air-cooled engines that were more suited to longer ranges and fuel efficiency. Moreover, according to Lindbergh, the NACA's earlier agreement to leave engine development to the manufacturers left the country with inadequate national research facilities for aircraft engines. Congress quickly responded, and an "Aircraft Engine Research Laboratory" was set up near the municipal airport in Cleveland, Ohio. This third new facility in the midwest gave the NACA a geographical balance, and the location also put it in a region that already had significant ties to the powerplant industry.

The site at Moffett field became Ames Aeronautical Laboratory in 1940, in honor of Dr. Joseph Ames, charter member of the NACA and its longtime chairman. The "Cleveland laboratory" remained just that until 1948, when it was renamed the Lewis Flight Propulsion Laboratory, in memory of its veteran director of research, George Lewis. Key personnel for both new laboratories came from Langley, and the two junior labs tended to defer to Langley for some time. By 1945, after several years of managing their own wartime projects, the Ames and Cleveland laboratories felt less like adolescents and more like peers of Langley. The NACA, like NASA after it, became a family of labs, but with strong individual rivalries.



Drag reduction studies on the Brewster XF2A-1 Buffalo influenced many later military fighters.

In the meantime, requirements of national security took priority. One significant project undertaken on the eve of World War II demonstrated the sort of work at Langley that had a major influence on aircraft design for years afterward. During 1938, the Navy became frustrated with the performance of a new fighter, the XF2A Brewster Buffalo. After the navy flew a plane to Langley, technicians set it up in the full scale tunnel for drag tests. It took only five days to uncover a series of small but negative aspects in the plane's design.

To the casual eye, the 250 MPH fighter with retractable gear appeared aerodynamically "clean." But the wind tunnel evaluations pinpointed many specific design aspects that created drag. The exhaust ports, gunsight, guns, and landing gear all protruded into the slipstream during flight; the accumulated drag effects hampered the plane's performance. By revamping these and other areas, the NACA reported a 10 percent increase in speed. Such a performance improvement, without raising engine power or reducing fuel efficiency, immediately caught the attention of other designers. Within the next two years, no fewer than 18 military prototypes went through the "cleanup" treatment given to the XF2A. Even though the Brewster Buffalo failed to win an outstanding combat record, others did, including the Grumman XF4F Wildcat, the Republic XP47 Thunderbolt, and the Chance Vought XF4N Corsair. The enhanced performance of these planes often represented the margin between victory and defeat in air combat. Moreover, specialists in the analysis of engine cooling and duct design later set the guidelines for inducing air into a postwar generation of jet engines.

The pace of war created personnel problems, especially when selective service began to claim qualified males after 1938. In the early years of the war, NACA personnel officers did considerable traveling each month to get deferments for employees working on national defense projects. Nonetheless, the NACA sometimes lost more employees than it was able to recruit. The issue was not resolved until early in 1944, when all eligible Langley employees were inducted into the Air Corps Enlisted Reserves, then put on inactive status under the exclusive management of NACA. The NACA draftees were given honorable discharges after Japan's surrender in 1945. The issue of the draft was not a threat to women, who made up about one-third of the entire staff by the end of the war. Although most of the female employees held traditional jobs as secretaries, increasing numbers held technical positions in the laboratories. Some did drafting and technical illustrating; some did strain-gauge measurements; others made up entire computing groups who worked through reams of figures pouring out of the various wind tunnels. A few held engineering posts. If women at Langley did not advance as rapidly in civil service as their male counterparts, most of the female employees later recalled that their treatment at the NACA was better than average when compared to other contemporary employers.

More women joined the NACA during World War II; technicians prepaired wind tunnel models, like this flying boast wing, for realistic tests.

Over the course of the war years, the NACA's relationship with industry went through a fundamental change. Since its inception, the agency refused to have an industry representative sit on the main committee, fearing that industry influence would make the NACA into a "consulting service." But the need to respond to industry goals in the emergency atmosphere of war led to a change in policy. The shift came in 1939, when George Mead became vice-chairman of the NACA and chairman of the Power Plants Committee. Mead had recently retired as a vice-president of the United Aircraft Corporation, and his position in the NACA, considering his high level corporate connections, represented a new trend. During the war, dozens of corporate representatives descended on Langley to observe and actually assist in testing. In the process, they forged additional direct links between the NACA and aeronautical industries.

Early in the war, extensive analysis of the Lockheed P-38 Lightning solved problems in high-speed dives.

1. Give three specific examples of technological innovation exhibited by the United States via NACA.

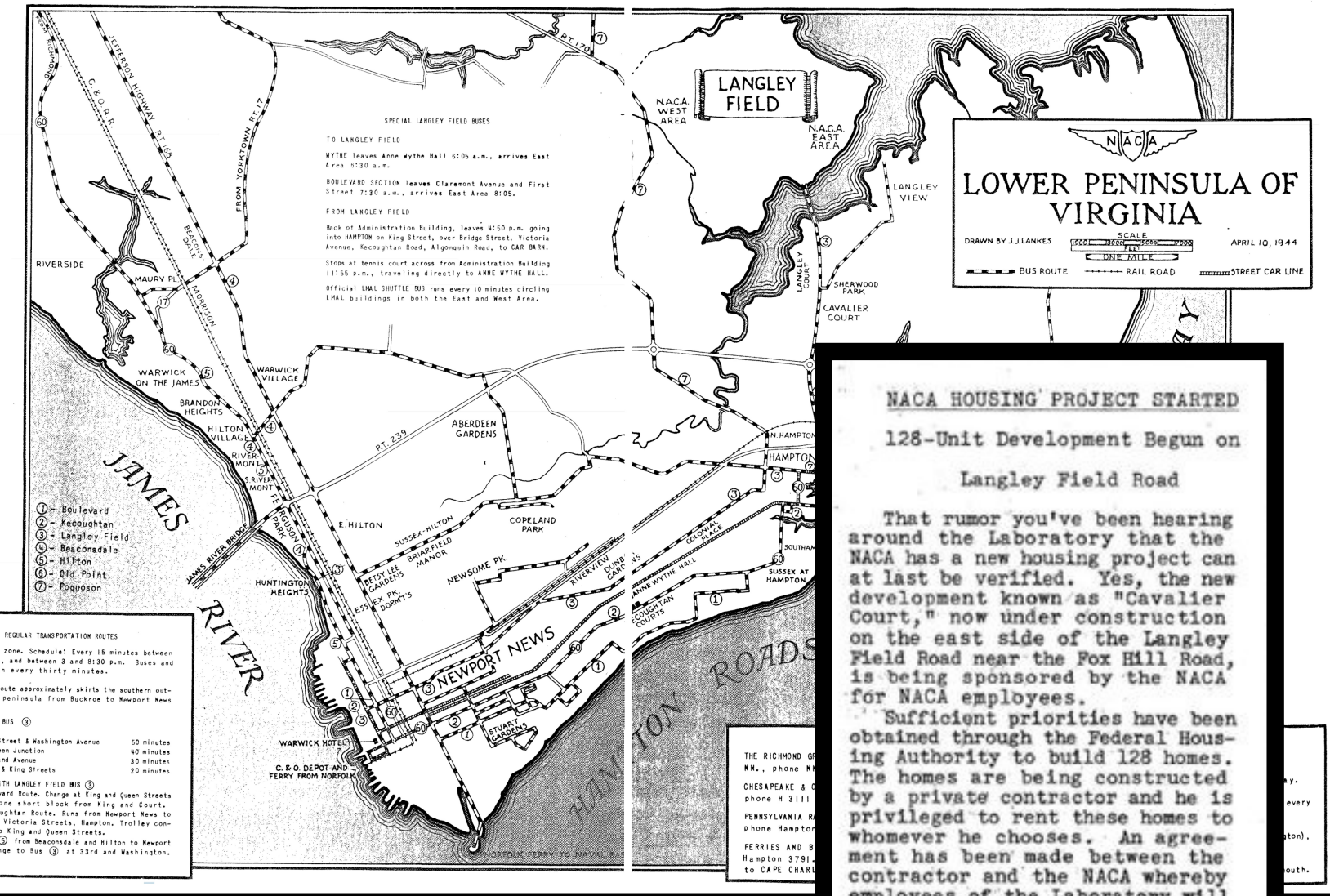
2. Which innovation do you believe to be the most important and why?

3. What are two specific challenges faced by NACA because of the war? Were they overcome? And, if so, how?

4. What does this chapter tell us about women's gender roles during the twentieth century?

5. How does this document demonstrate societal impacts of NASA Langley during WWII?

Document 6 &7 : *Public Transportation and housing provided by NACA for employees,* 1944. Map and transportation schedule included.



NACA HOUSING PROJECT STARTED

128-Unit Development Begun on Langley Field Road

That rumor you've been hearing around the Laboratory that the NACA has a new housing project can at last be verified. Yes, the new development known as "Cavalier Court," now under construction on the east side of the Langley Field Road near the Fox Hill Road, is being sponsored by the NACA for NACA employees.

Sufficient priorities have been obtained through the Federal Housing Authority to build 128 homes. The homes are being constructed by a private contractor and he is privileged to rent these homes to whomever he chooses. An agreement has been made between the contractor and the NACA whereby employees of the Laboratory will be given first consideration. This is an ideal situation because it is possible to establish a new community made up entirely of NACA employees provided enough people are interested.

According to the present construction schedule the first few homes should be ready for occupancy around February 1, 1943. After the initial opening several homes should be ready every week thereafter until the project is complete.

The new homes are being constructed according to five different plans; the whole unit, therefore, will not be just a monotonous row of identical houses. Atypical unit is shown in the sketch; the other four types are equally attractive.

We sincerely hope that the Laboratory staff will be interested in this development and will grasp this opportunity to have a real NACA community. Further detailed information can be obtained from Mr. William A. Thompson at 272.

1. Why was it necessary for NASA to supply public transportation and housing for their employees?

2. What impacts could the creation of easily accessible and free public transportation and housing have on American society?

Document 8 : Explanation of Structures and Materials Research Facility, 1941.

Structures Research Laboratory

Description:

Floor Space - 240 by 100 ft. with 35 ft. ceiling

Testing equipment:

Four tension-compression testing machines; the largest having 1,200,000 lb. capacity. Three loading and weighing jacks. Supporting abutment with face of 530 sq. ft. 172 optical strain gages and 250 electrical strain gage channels.

Partially completed combined load testing machine.

Purpose of Equipment:

To conduct structural research directed toward increased efficiency and safety of aircraft.

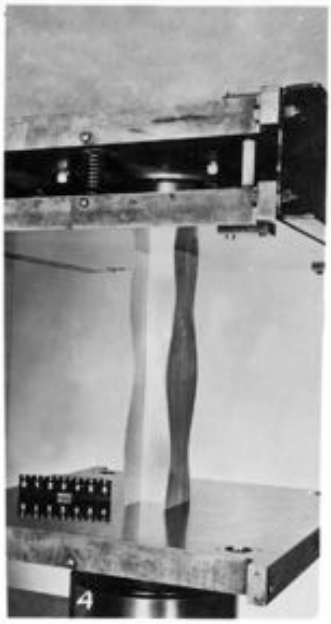
Research Projects:

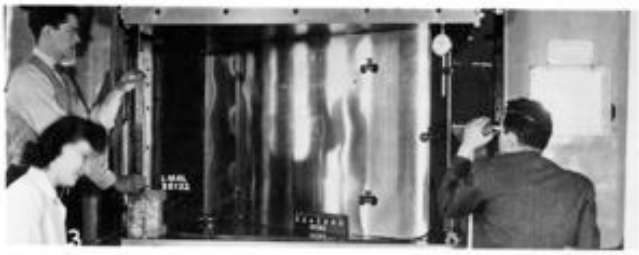
a) Investigation of stress distribution in reinforced shell structures.
b) Study of elastic instability of plate and shell type structures.
c) Development of aerodynamically smooth wing construction.
d) Response of structures to shocks and impacts.
e) Structural evaluation of materials.

Illustrations:

1. Stiffened panel with door opening under load in 1,200,000 pound testing machine.
2. Stiffened shell with electrical strain gages installed to study elastic instability resulting in wrinkled skin.
3. Wing section for the XA-39 airplane under load to study surface smoothness for low drag.
4. Buckled column under load used in structural evaluation of materials.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
LANGLEY MEMORIAL AERONAUTICAL LABORATORY - LANGLEY FIELD, VA.





1. What is the purpose of the research conducted at the facility discussed in this document?

2. What kind of equipment was used at this facility?

3. How might the research conducted at this facility still affect technology today?

4. How did the development of advanced aviation technology help the United States ahead during WWII?

5. How could the research conducted at this facility have impacted American society during WWII?

Part 2: Formulating the Argument

Directions: You will be asked to write a five paragraph essay answering the following question: **how did the NASA Langley Research Center impact American society during WWII?** Using the documents above, you must formulate a thesis statement with at least three references to specific pieces of evidence. Based on your multiple document analysis, fill out the following chart.

Topic	**Document #(s) Discussing Topic**	**At least 2 Document-Based Examples Demonstrating NASA Langley's Impact on Topic**
Impact on Employment		
Impact on Technological Development		
Impact on Gender Roles		

Based on the evidence in the chart, **create a thesis statement** responding to the following question: **How did NASA Langley impact American society during World War II?**

Part 3: Writing the Essay

The final part of this assignment is to complete a five paragraph essay answering the question below. Using your research, the evidence chart, and your thesis statement, please create an essay with the following components: introductory paragraph with clear thesis statement, 3 supporting paragraphs using evidence, and closing paragraph that summarized your essay and findings.

Question: How did the NASA Langley Research Center have an impact on American society during WWII?

Grading: Essay will be graded according to the following rubric

CATEGORY	4 - Above Standards	3 - Meets Standards	2 - Approaching Standards	1 - Below Standards	Score
Attention Grabber	The introductory paragraph has a strong hook or attention grabber that is appropriate for the audience. This could be a strong statement, a relevant quotation, statistic, or question addressed to the reader.	The introductory paragraph has a hook or attention grabber, but it is weak, rambling or inappropriate for the audience.	The author has an interesting introductory paragraph but the connection to the topic is not clear.	The introductory paragraph is not interesting AND is not relevant to the topic.	
Focus or Thesis Statement	The thesis statement names the topic of the essay and outlines the main points to be discussed.	The thesis statement names the topic of the essay.	The thesis statement outlines some or all of the main points to be discussed but does not name the topic.	The thesis statement does not name the topic AND does not preview what will be discussed.	
Evidence and Examples	All of the evidence and examples are specific, relevant and explanations are given that show how each piece of evidence supports the author\'s position.	Most of the evidence and examples are specific, relevant and explanations are given that show how each piece of evidence supports the author\'s position.	At least one of the pieces of evidence and examples is relevant and has an explanation that shows how that piece of evidence supports the author\'s position.	Evidence and examples are NOT relevant AND/OR are not explained.	
Accuracy	All supportive facts and statistics are reported accurately.	Almost all supportive facts and statistics are reported accurately.	Most supportive facts and statistics are reported accurately.	Most supportive facts and statistics were inaccurately reported.	
Closing paragraph	The conclusion is strong and leaves the reader solidly understanding the writer\'s position. Effective restatement of the position statement begins the closing paragraph.	The conclusion is recognizable. The author\'s position is restated within the first two sentences of the closing paragraph.	The author\'s position is restated within the closing paragraph, but not near the beginning.	There is no conclusion - the paper just ends.	
Grammar & Spelling	Author makes no errors in grammar or spelling that distract the reader from the content.	Author makes 1-2 errors in grammar or spelling that distract the reader from the content.	Author makes 3-4 errors in grammar or spelling that distract the reader from the content.	Author makes more than 4 errors in grammar or spelling that distract the reader from the content.	

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